



Electrospinning

Overview:

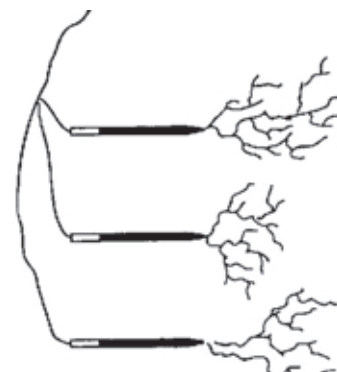
About 50 patents for electrospinning polymer melts and solutions have been filed in the past 60 years. However, there is no known commercial process for electrospinning. The micro-fine fibers produced by electrospinning randomly collect into thin non-woven fiber mats that behave like micro-porous membranes. The goal of this program is to utilize electrospinning to produce seamless garments by integrating advanced manufacturing with fiber electrospinning. This would introduce multi-functionality (flame, chemical, environmental protection) by blending fibers into electrospun layers in combination with polymer coatings. The concept is premised on electrospinning fibers directly onto 3-D screen forms obtained from 3-D whole body scanning.

Description:

- Electrospinning is a process by which a suspended drop of polymer is charged with tens of thousands of volts. At a characteristic voltage the droplet forms a Taylor cone, and a fine jet of polymer releases from the surface in response to the tensile forces generated by interaction of an applied electric field with the electrical charge carried by the jet. This produces a multi-filament fiber of polymer. This jet can be directed to a grounded surface and collected as a continuous web of fibers ranging in sized from 0.05 micron to 20 microns as the primary jet splays every 5-10 mm into smaller fiber jets in the electric field.
- Military applications for multifunctional fabrics warrant the investigation of novel textile manufacturing technologies, such as electrospinning, which has the capability of lacing together numerous types of polymers and fibers in a direct one step operation to produce ultrathin layers of protection. These fibers are also expected to be excellent substrates for immobilized enzymes and other catalyst systems to break down toxic chemicals. Recent results show that these fiber webs are efficient aerosol filters.
- Electrospinning also has potential for computer aided manufacturing of garments by simply spraying fiber layers onto advanced 3-D forms generated from laser scanning. As the technique matures, there is a broad range of opportunity for commercial applications on apparel — outdoor wear, exercise wear, environmental protection ensembles.
- Electrospinning offers an alternative to conventional manufacturing techniques with potential for reduction in manufacturing costs, improved comfort and durability of garments and production timeliness. This breakthrough technology would also have the potential for creating a whole new industry concept in manufacturing and supply.



Electrospinning Apparatus Concept



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